

California Division of Mines and Geology  
Supplement<sup>#1</sup> to Fault Evaluation Report FER-41

April 20, 1979

1. Name of fault

Whittier (see report of 12/12/77).

2. Additional references

Hannan, D.L., Lung, R., and Leighton, F.B., 1978, Geologic investigation of recency of fault activity by surface trenching on the Whittier fault: Semi-annual Technical Report to U.S. Geological Survey by F.B. Leighton and Associates, December 2, 1978, Contract No. 14-08-0001-16821, 17 p., 2 app., 1 pl. (Preliminary log of Trench 22, submitted by D.L. Hannan in April 1979, documents faulting in Holocene alluvium.)

5. Summary of available data

Recent trench investigations by Leighton and Associates in the Prado Dam quadrangle document Holocene activity for the main strand of the Whittier fault (Hannan, et al, 1978). Specifically, a carbonaceous wood sample from a faulted alluvial unit was dated at 2200 year bp by radiometric analysis of  $C^{14}$  (Hannan, D.L., p.c., 1979). This sample was excavated from Trench 22 in Lost Canyon (see figure 3a). The location of the fault locally coincides with the trace identified by Durham and Yerkes (1974, pl. 1) and lies 100-200 feet north of the trace mapped by Miller, et al (1977, pl. 1).

According to Hannan, et al., the fault encountered in trenching juxtaposed unlike Miocene bedrock, as well as displacing and deforming overlying late Quaternary alluvium and colluvium. They state that in Trench 22 the fault zone is 30 to 35 feet wide, is vertical to steeply north-dipping, and displays both horizontal and oblique slickensides. Trench 22 clearly demonstrates that recent uplift is to the north in the alluvium-colluvium, and the systematically offset drainages in the La Habra quadrangle demonstrate a large component of right-lateral

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slip. Thus, the Whittier fault locally is a right-reverse oblique-slip fault (Hannan, et al.).

Recent trenching to the west, in the Esperanza area of the Yorba Linda quadrangle, verifies the location of the main trace of Miller, et al. and reveals "older alluvium" (Quaternary) to be faulted against bedrock (R. Miller, p.c., 4/18/79; <sup>pencil notations on</sup> see figure 3b). According to Miller, the main trace of the Whittier fault is well-located in the Prado Dam and Yorba Linda quadrangles, based on lithologic truncation. The trace shown by Miller, et al (1977) is considered by him to be located with an accuracy of 100 or 200 feet (Miller, p.c.). Moreover, his main trace dips steeply to the north and coincides with systematically offset (right-lateral) drainages across <sup>the Yorba Linda and</sup> La Habra quadrangles.

Near Tonner Canyon, the northwestern 2-mile segment of the fault in the Yorba Linda quadrangle is less well-defined, splitting into several significant traces. Two of the northern branch faults have been exposed by trenching (Nicolli, 1970; Tepel, 1971), which reveals possible Holocene faulting. This was discussed previously in FER-41 of Drew Smith (p. 6-7, figure 3b). As shown on the Yorba Linda, La Habra, and Whittier quadrangles (figures 3b, 3c, and 3d), the northwestern segment of the Whittier fault zone consists of multiple strands up to a mile wide and is less well-defined than the southeastern segment. The main lithologic breaks are fairly well-defined as far to the northwest as Turnbull Canyon in the Whittier quadrangle (Yerkes, 1972, pl. 1 and 2), but the most recently active breaks are not certain. The northwestern segment shows less evidence of recent right-lateral offset judging from the drainage patterns, and it is probable that the reverse component of faulting is predominant in that segment. Late Quaternary alluvium is mapped as faulted along the main Whittier fault trace as far to the northwest as the Orange County boundary (figure 3c). Northwest of the county line, there is no evidence that the Whittier fault cuts the "older alluvium" that is identified as late Pleistocene and Holocene (?) by

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Yerkes (1972, pl. 1; also see figure 3c in FER-41). The data suggest that either the recency or the magnitude of faulting decreases to the northwest. Also, faulting may be distributed along several principle strands.

The seismicity, discussed in FER-41, strongly suggests that the Whittier fault is active at depth. Figure 2a and Lamar (1972, pl. 1) indicates seismic activity in the central and eastern segments of the fault. Lamar (p. 28-40) also discusses precise levelling across the Whittier fault in Los Angeles County and concludes there is no evidence of displacement across the fault, although there is relative uplift across the Puente Hills that border the fault on the northeast.

#### 6. Air photo Interpretation

Not done due to lack of available time; presumably used by previous workers who mapped fault in detail (e.g. Miller, et al, 1977; Yerkes, 1972; Durham and Yerkes, 1964).

#### 7. Field Investigations

The trench excavations of Hannan, et al. were examined briefly on December 15, 1978. Complex faulting of the alluvial units was observed in Trench 22, Prado Dam quadrangle. There was no time available for additional field checking.

#### 8. Conclusions

The southeast segment of the Whittier fault offsets and otherwise deforms alluvium of late Holocene age in the Prado Dam quadrangle. The fault is fairly well-defined in this area by aligned systematically offset drainages. Strike-slip and reverse (north side up) faulting since late Miocene time is measured in thousands of feet, making the Whittier fault both an important structural feature.

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The main trace of the fault is fairly well defined as far to the west as Tonner Canyon in the Yorba Linda quadrangle, where late Quaternary activity has been documented along the main trace. Although Holocene activity may have occurred, this has not been demonstrated. However, possible Holocene faulting is suggested on two branch faults just west of Tonner Canyon where the fault splits into multiple strands that constitute a zone as much as a mile wide.

Farther to the northwest, in the La Habra and Whittier quadrangles, the Whittier fault is a zone of multiple fault strands that have been carefully mapped (Yerkes, 1972) but have not been evaluated in terms of recent fault rupture northwest of the Orange-Los Angeles County line (see Miller, et al). In fact, there is no reported evidence of even late Quaternary displacement northwest of that line, and the identification of the most recently active trace is uncertain. Historic seismicity is associated with the central and southeastern parts of the Whittier fault and supports the <sup>interpretation</sup> of Holocene surface faulting along those segments. Historic seismicity cannot be uniquely attributed to the northwestern segment of the Whittier fault, although it is permissive based on "B" quality data (figure 2b).

#### 9. Recommendations

The criteria of "sufficiently active and well-defined" appear to be met for the Whittier fault southeasterly from the Tonner Canyon area. Therefore, it is recommended that that segment be zoned for special studies under the Alquist-Priolo Act in the Prado Dam and Yorba Linda quadrangles. Zoning should be based on the main trace of Miller, et al (1977), supplementing with Hannan, et al, (1978).

Although the northwestern segment of the fault is structurally related to the southeastern segment, there is no firm surface evidence of Holocene activity for the former. Moreover, the most recently active strand of the northwestern segment is not apparent from the data available. That segment is considered to

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be complex and insufficiently well defined to warrant zoning in the La Habra and Whittier quadrangles.

If time is available, old aerial photos and a brief field check should be made along the Whittier fault to verify the data and conclusions of this report.

10. Report prepared by

*I have reviewed, and  
I concur with your  
conclusions and recommendations,  
EWH  
4/20/79*

*Earl W. Hart*

E.W. HART  
April 20, 1979

# EPICENTERS IN THE L. A. AREA, **A** QUALITY

TRANSVERSE MERCATOR PROJECTION

SCALE = 1/250000

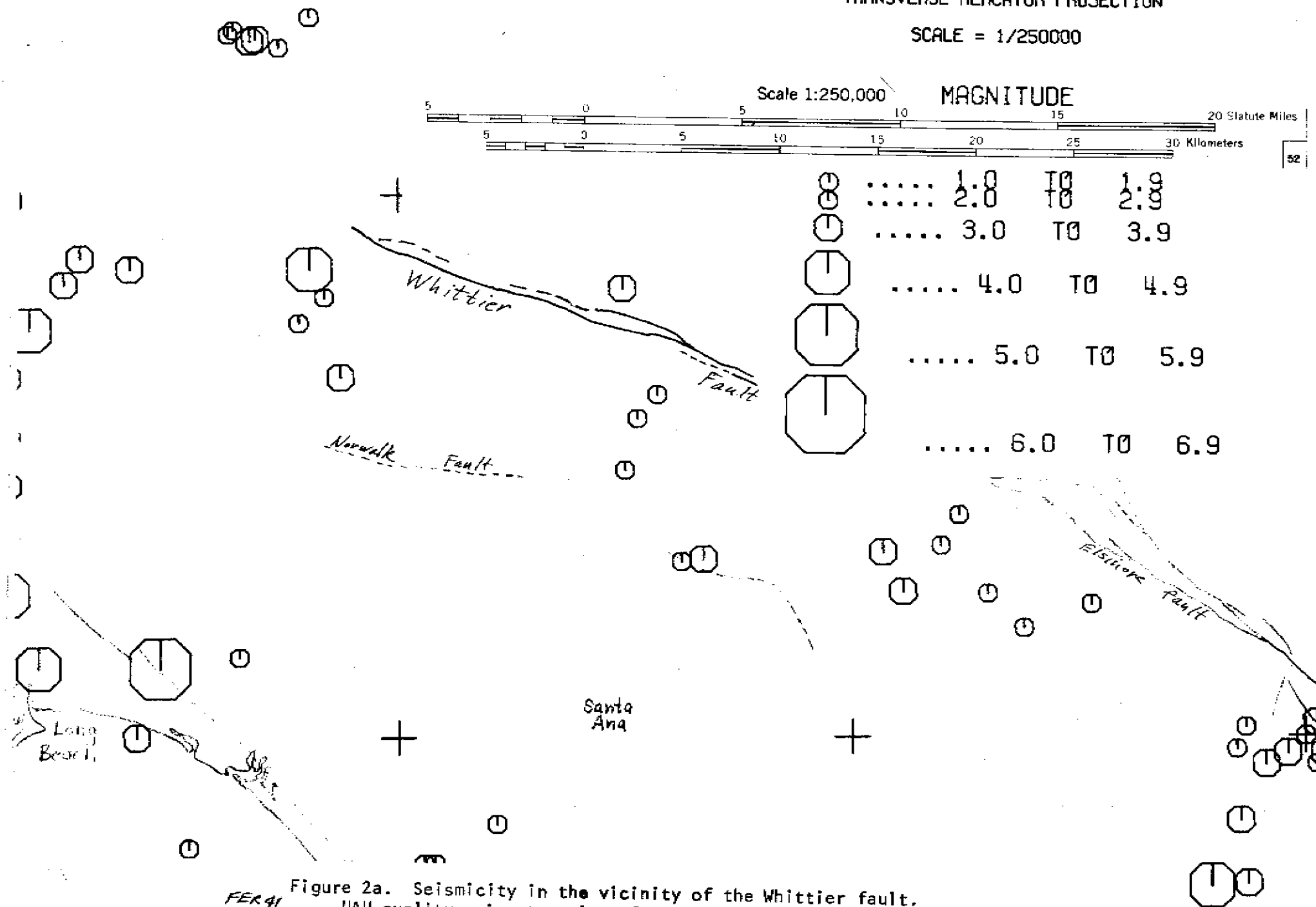
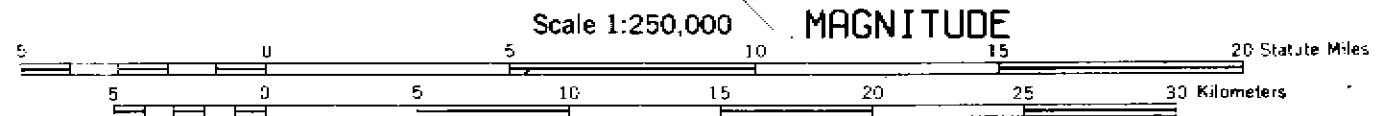


Figure 2a. Seismicity in the vicinity of the Whittier fault.  
"A" quality epicenter plots from Real, et al (1977).  
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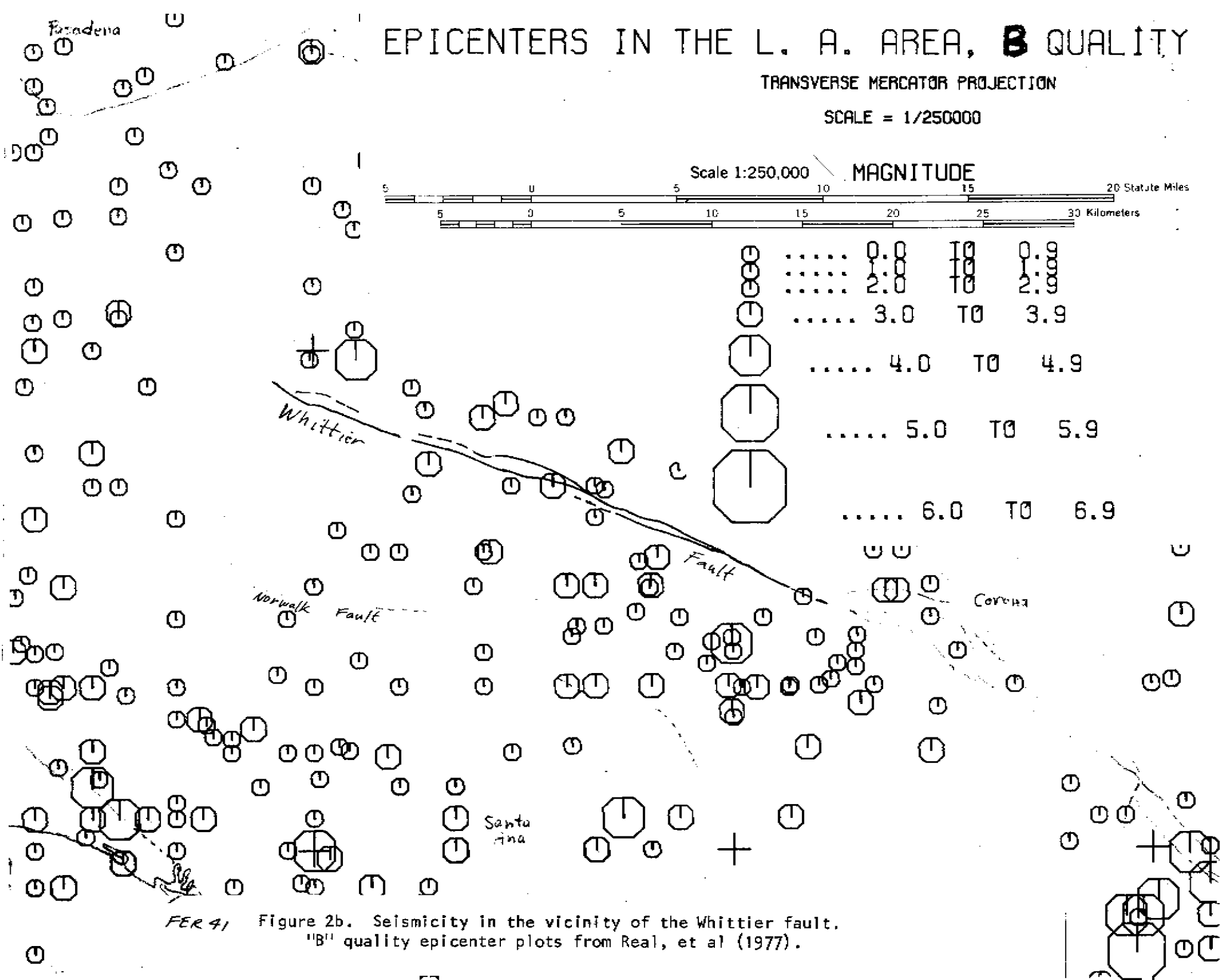
# EPICENTERS IN THE L. A. AREA, **B** QUALITY

TRANSVERSE MERCATOR PROJECTION

SCALE = 1/250000



MAGNITUDE		
0.0	TO	0.9
1.0	TO	1.9
2.0	TO	2.9
3.0	TO	3.9
4.0	TO	4.9
5.0	TO	5.9
6.0	TO	6.9



FER 41 Figure 2b. Seismicity in the vicinity of the Whittier fault.  
"B" quality epicenter plots from Real, et al (1977).